Abstract No. huck453

Phase separation in oxygen doped $La_{2-x}Sr_xNiO_{4+\delta}$ (0.02≤x≤0.12).

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Beamline: X7A

Introduction: Oxygen intercalation in $La_2NiO_{4+\delta}$ causes a number of interesting effects, as for example phase separation and ordering of the interstitial oxygen ions. Starting from stoichiometric La_2NiO_4, with increasing δ first disordered oxygen phases and then oxygen ordered phases with different staging types of the interstitial oxygen layers were observed. In the disordered oxygen regime for certain values of δ the system phase separates into oxygen rich and oxygen poor phases. Correspondingly one can find pure and mixed structural phases of the LTO (*Abma*) and the LTT (*P4₂/ncm*) type. Excess oxygen also causes a doping of the NiO_2 planes with charge carriers. For particular concentrations the charge carriers form a static stripe pattern with an incommensurability that is independent of the interstitial oxygen superstructure and similar to the charge stripe order in Sr doped $La_{2-x}Sr_xNiO_4$.

Recently, in $La_{2-x}Sr_xNiO_4$ with x=0.04 a similar biphasic LTO+LTT phase as in $La_2NiO_{4+\delta}$ with δ~0.02 was found. As the charge carrier content p=x=2δ in these two samples is supposed to be the same, the observation raises the question whether the phase separation is driven by the charge carriers, the excess oxygen, or both.

Experiment and Results: Series of $La_{2-x}Sr_xNiO_{4+\delta}$ samples with various amount of excess oxygen δ have been prepared for fixed Sr content x=0.02, 0.04, 0.08, and 0.12. To adjust δ small pieces were annealed at 1000K in atmospheres with different partial oxygen pressure, the fugacity f_{O2} ranging from -12 to 0. Synchrotron x-ray powder diffraction patterns were collected at beamline X7A at a wavelength of λ=0.7Å. Temperature was controlled using a closed-cycle He displex refrigerator. Powder samples were contained in glass capillaries (ø0.4mm) sealed under argon. Rietveld refinements were carried out using Rietica. So far, mainly samples with Sr content x=0.04 have been studied. Fig. 1 shows the temperature dependence of the lattice parameters *a,b,c* for biphasic $La_{1.96}Sr_{0.04}NiO_{4+\delta}$. At low T no clear evidence for a transition LTO → LTLO (*Pccn*), as observed in biphasic $La_2NiO_{4+\delta}$, was found in our sample [1]. In Fig. 2 we plot the lattice parameters of $La_{1.96}Sr_{0.04}NiO_{4+\delta}$ at room temperature as a function of f_{O2}. With increasing f_{O2} (increasing δ) we find the same sequence LTO → LTO+LTT → LTT as in $La_2NiO_{4+\delta}$ (the chemical analysis of δ is in process).

Future plans: To work out a conclusive phase diagram of (x,δ,T) further samples have to be studied at X7A.

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References: [1] J. M. Tranquada et al., Phys. Rev. B 50, 6340 (1994), [2] M. Medarde, and J. Rodriguez-Carvajal, Z. Phys. B 102, 307 (1997)

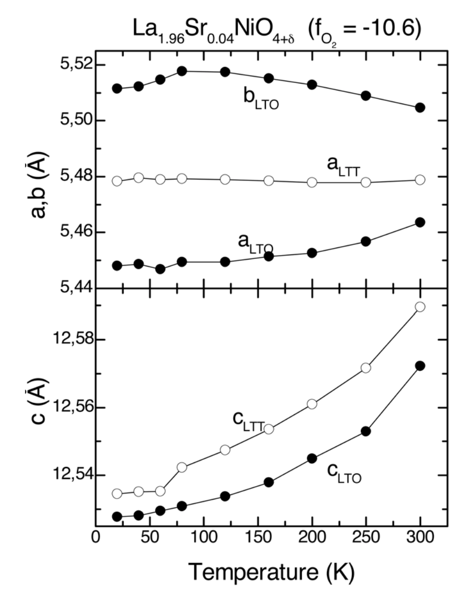

Fig. 1: Lattice parameters *a,b,c* of $La_{1.96}Sr_{0.04}NiO_{4+\delta}$ (f_{O2} = -10.6) as a function of T.

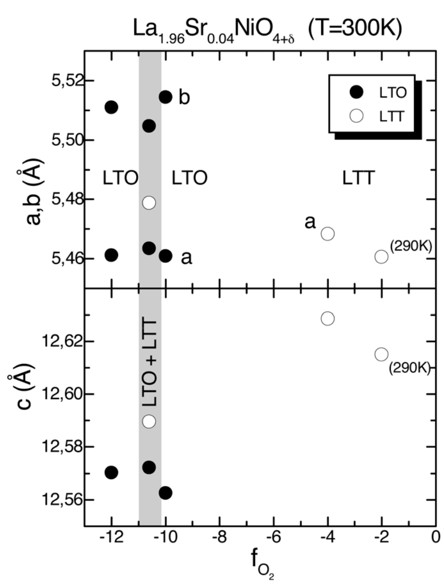

Fig. 2: Lattice parameters *a,b,c* of $La_{1.96}Sr_{0.04}NiO_{4+\delta}$ as a function of the fugacity f_{O2}.